

# Utah Water Supply Briefing

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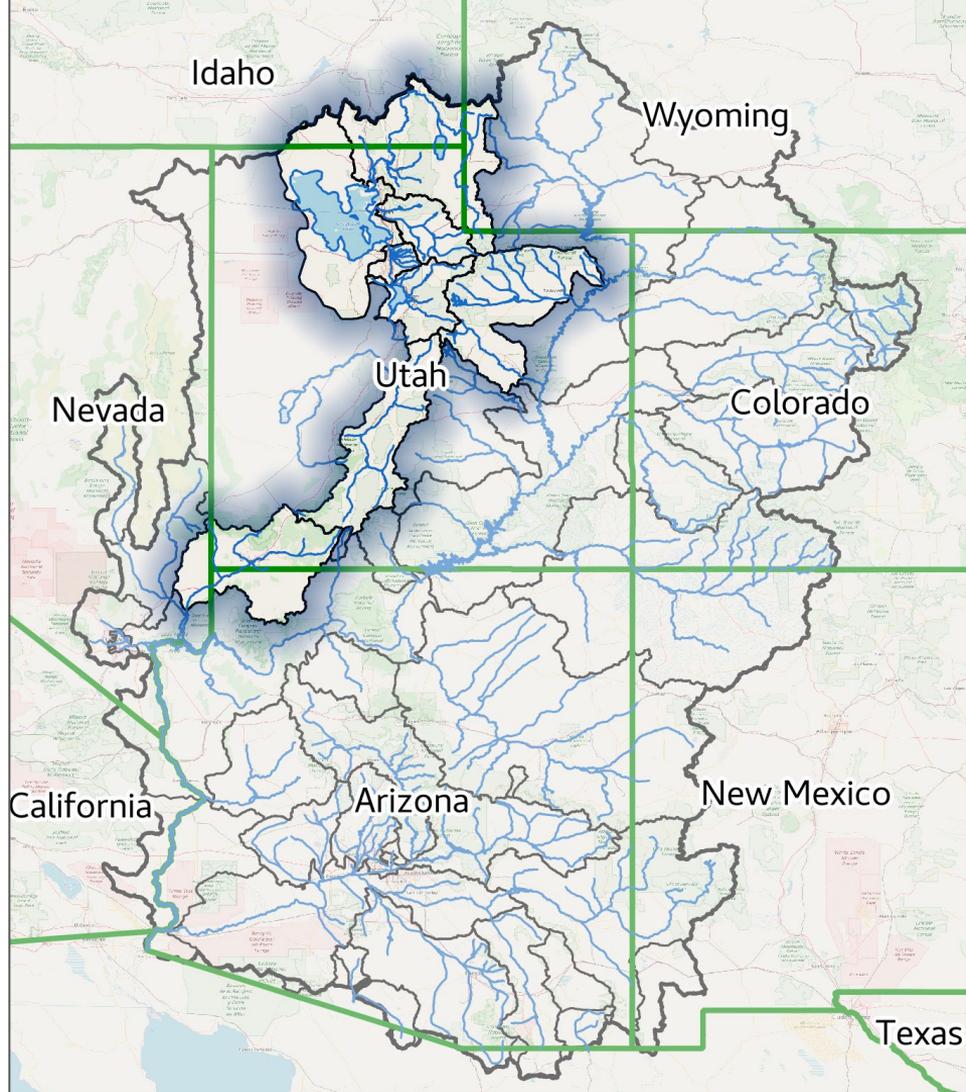
February 5<sup>th</sup>, 2021

Colorado Basin River Forecast Center

Presenter: Patrick Kormos - Hydrologist

Utah Forecasters: Brent Bernard, Zach Finch,  
Patrick Kormos

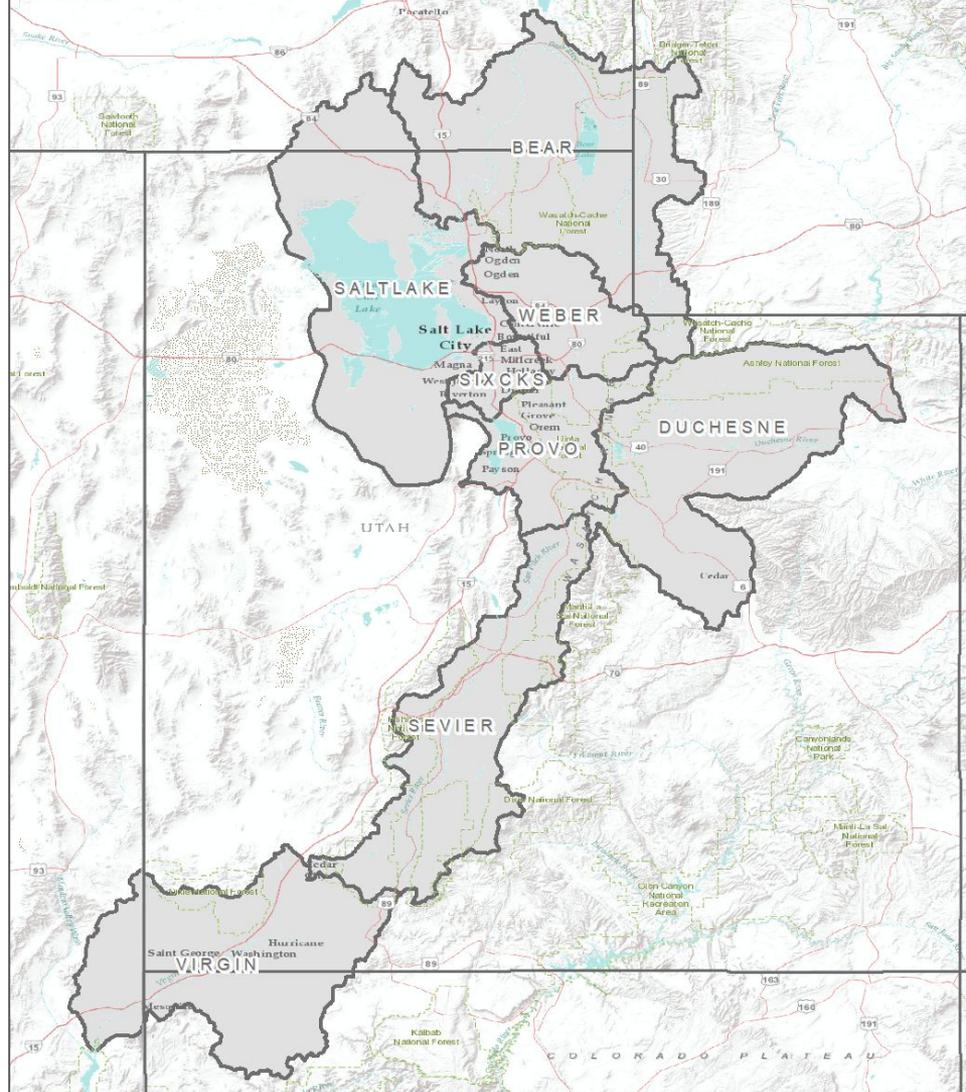
Questions: Type questions into the 'Questions'  
Box or Raise Hand



# Utah Water Supply Briefing

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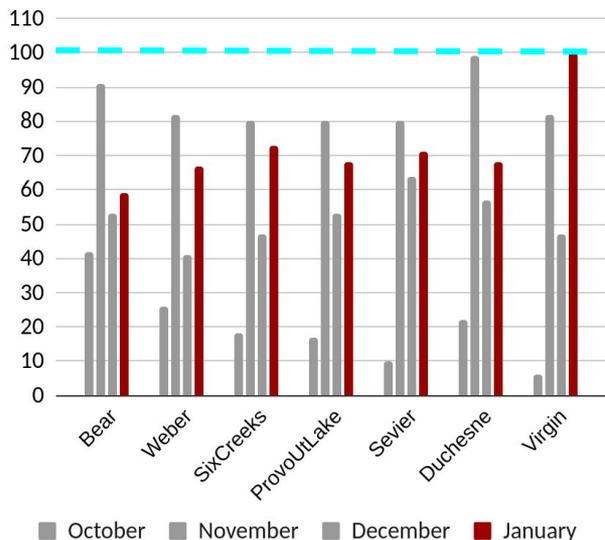
1. Weather Review (Precipitation)
2. Current Snowpack
3. 2021 Water Supply Forecasts
4. Forecast Error
5. Upcoming Weather
6. CBRFC Model Error and External Snow Data
7. Contacts & Questions



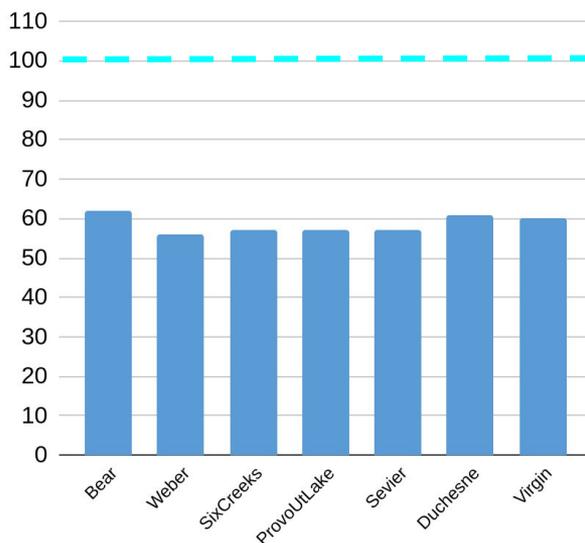
# Utah Weather Review - Precipitation up to Feb. 1, 2021

- Below normal seasonal precipitation - All Basins
- Below normal January precipitation except for Virgin

Monthly Precipitation Percent of Normal



Water Year Precipitation Percent of Normal



Forecast Group	Percent of WY normal
Bear	60
Weber	55
Six Creeks	55
Provo	55
Sevier	55
Duchesne	60
Virgin	60

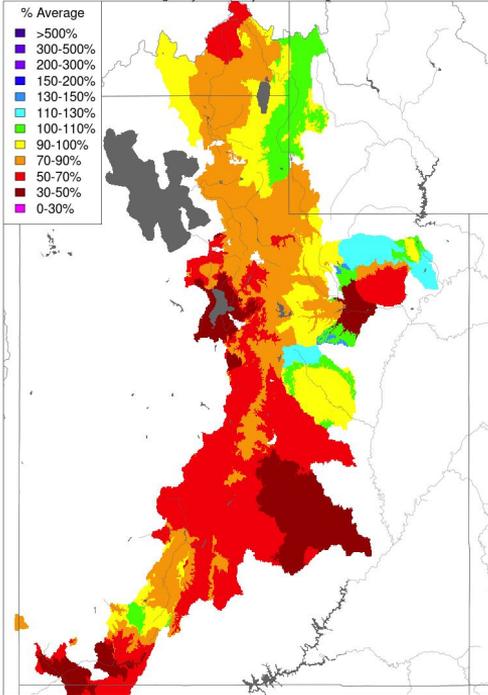
# Utah Weather Review - Monthly Precipitation

November 2020

December 2020

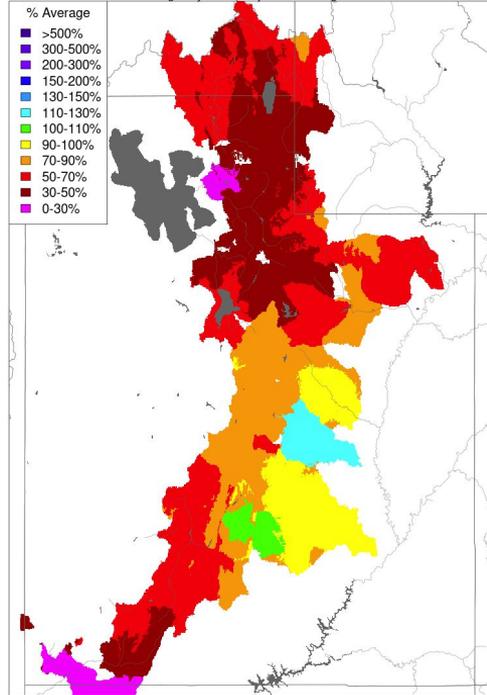
January 2021

**Monthly Precipitation - November 2020**  
Averaged by Basin, Major Contributing Areas



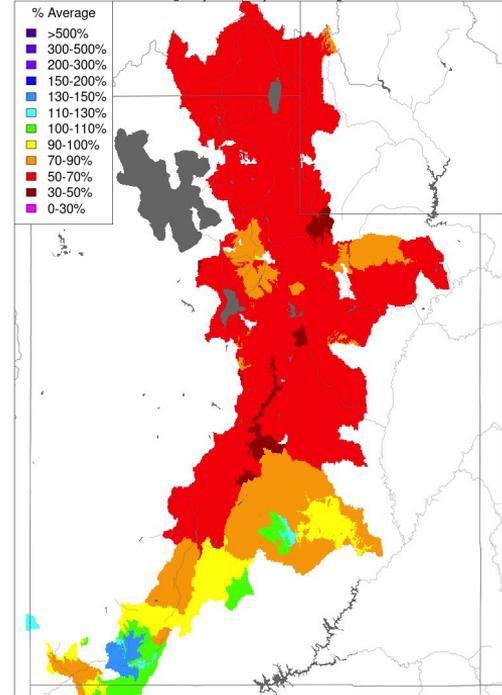
Prepared by NOAA, Colorado Basin River Forecast Center  
Salt Lake City, Utah, [www.cbrfc.noaa.gov](http://www.cbrfc.noaa.gov)

**Monthly Precipitation - December 2020**  
Averaged by Basin, Major Contributing Areas



Prepared by NOAA, Colorado Basin River Forecast Center  
Salt Lake City, Utah, [www.cbrfc.noaa.gov](http://www.cbrfc.noaa.gov)

**Monthly Precipitation - January 2021**  
Averaged by Basin, Major Contributing Areas

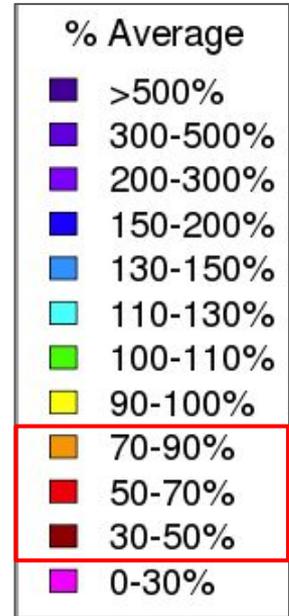
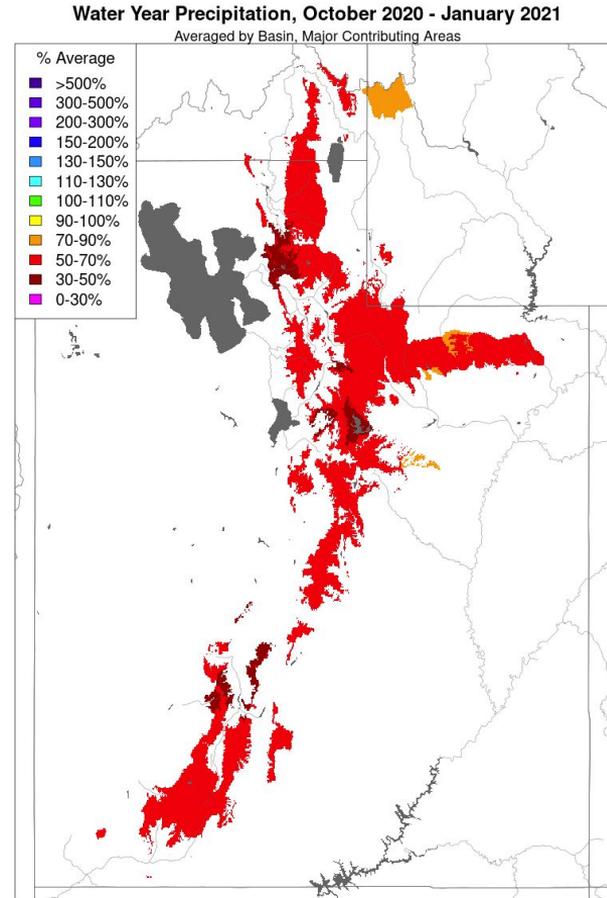
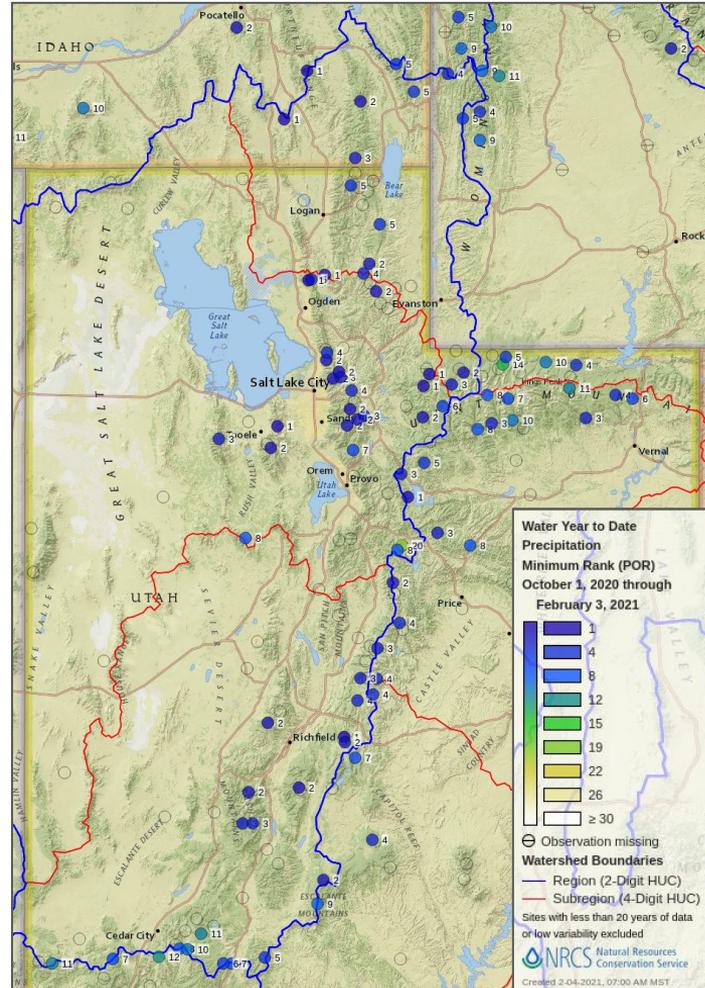


Prepared by NOAA, Colorado Basin River Forecast Center  
Salt Lake City, Utah, [www.cbrfc.noaa.gov](http://www.cbrfc.noaa.gov)

**% Average**

- >500%
- 300-500%
- 200-300%
- 150-200%
- 130-150%
- 110-130%
- 100-110%
- 90-100%
- 70-90%
- 50-70%
- 30-50%
- 0-30%

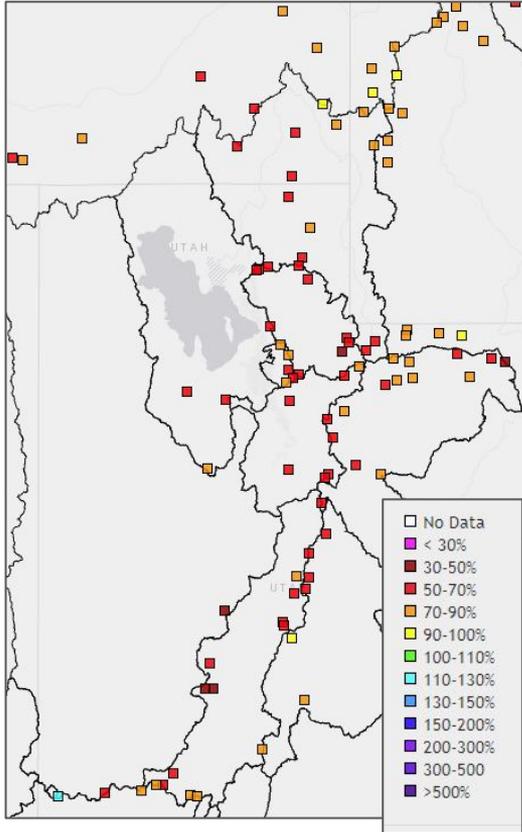
# Utah Weather Review - Water Year Precipitation - Min. Rank - %Avg.



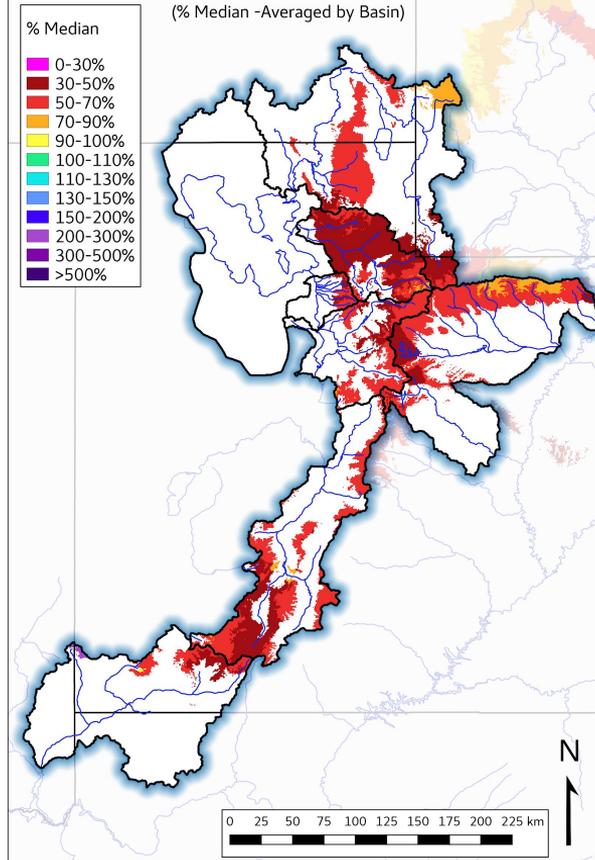
- Most stations rank in bottom 10.

# Utah Current Snowpack - February 2021

## SNOTEL (Observed)



## CBRFC Model Snow, Significant Areas - Feb. 3, 2021

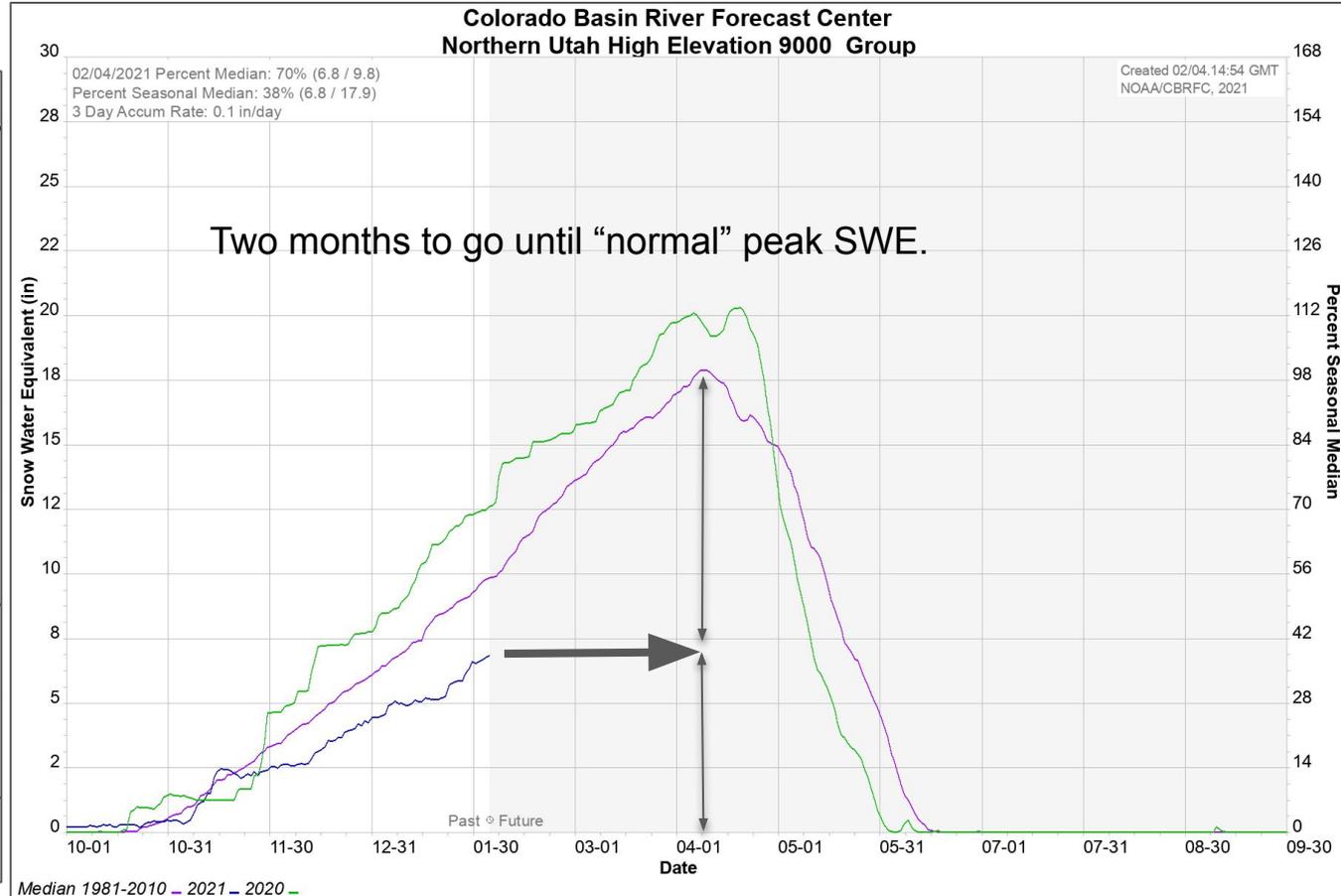
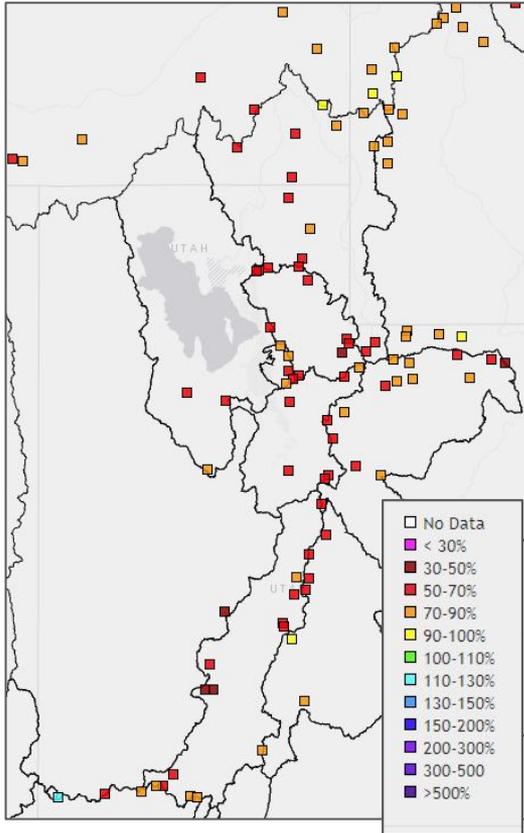


## As of February 1, 2021 CBRFC Snow Groups (SNOTEL Stations)

- Bear: 65% of WY normal
- Weber: 60% of WY normal
- Six Cr: 65% of WY normal
- Provo: 60% of WY normal
- Duchesne: 65% of WY normal
- Sevier: 60% of WY normal
- Virgin: 75% of WY normal

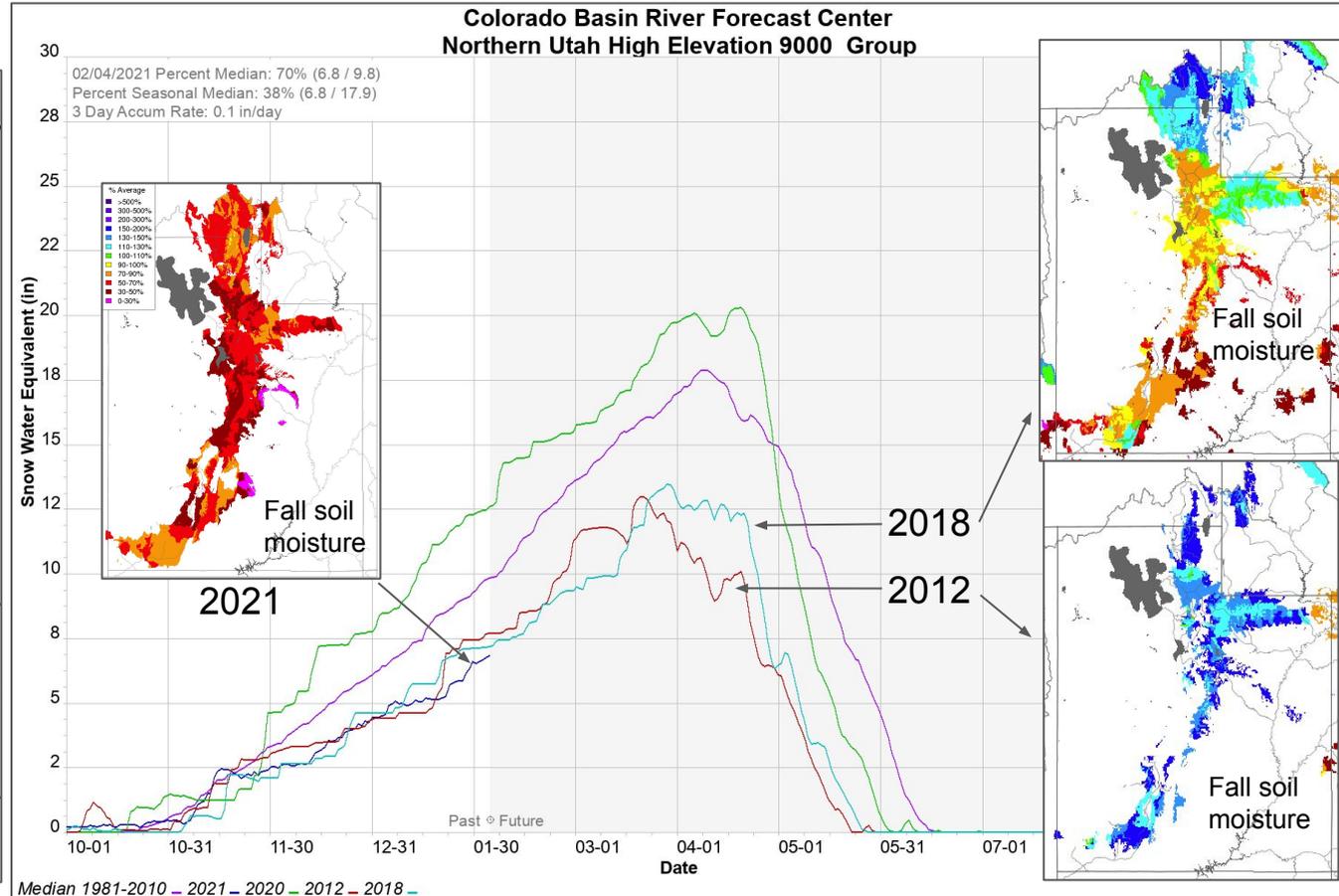
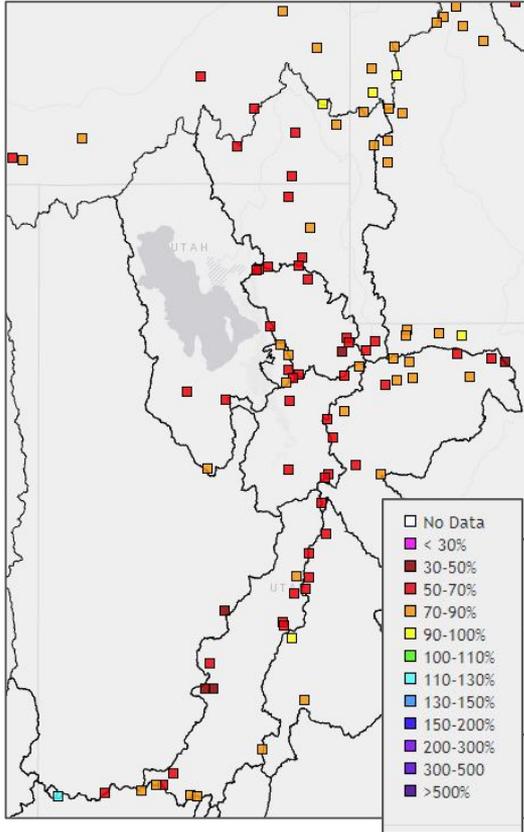
# Utah Current Snowpack

## SNOTEL (Observed)



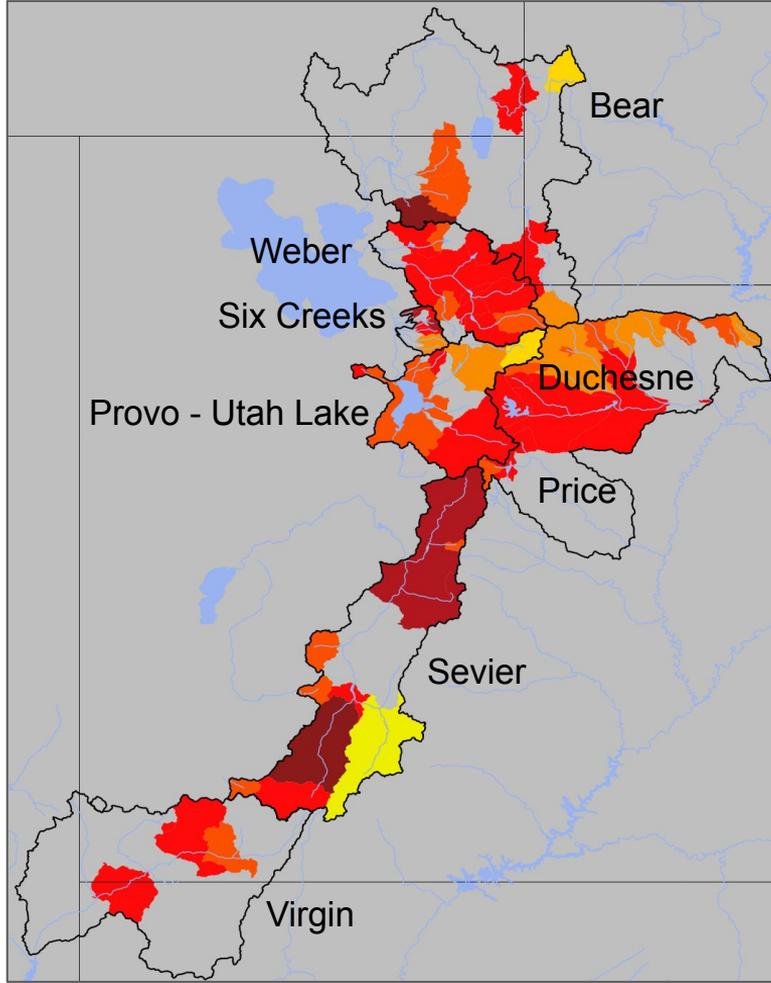
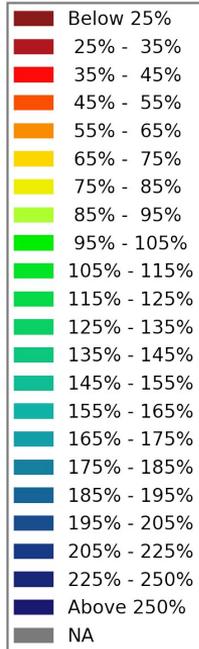
# Utah Current Snowpack - recent dry year comparison - fall soil moisture

SNOTEL (Observed)



# Utah Water Supply Forecasts - Overview

Percent of Average



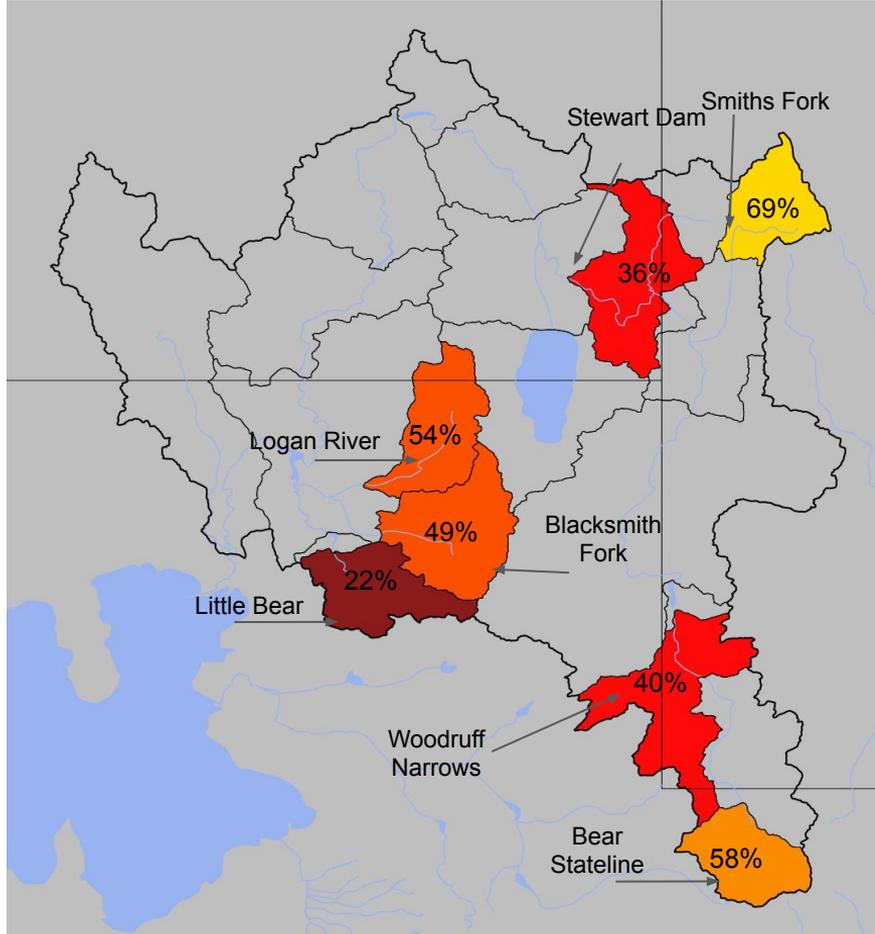
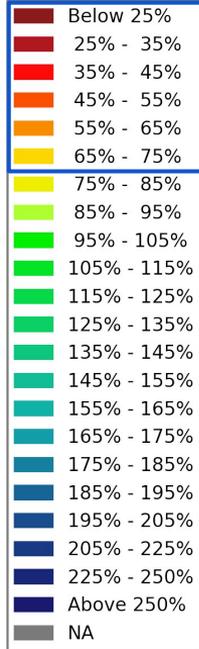
- February 1 Forecast for April-July Volume in 1000's acre feet (KAF)
- April-July Forecast Streamflow Volumes are in percent of 1981-2010 average

Median value of the ...  
 ...individual forecasts (in % of average)  
 ...by Forecast Group.

Bear	50
Weber	45
Six Creeks	40
Provo / Utah Lake	50
Sevier	40
Duchesne	50
Virgin	40

# Utah Water Supply Forecasts - Bear

Percent of Average



## Bear River Basin Forecasts

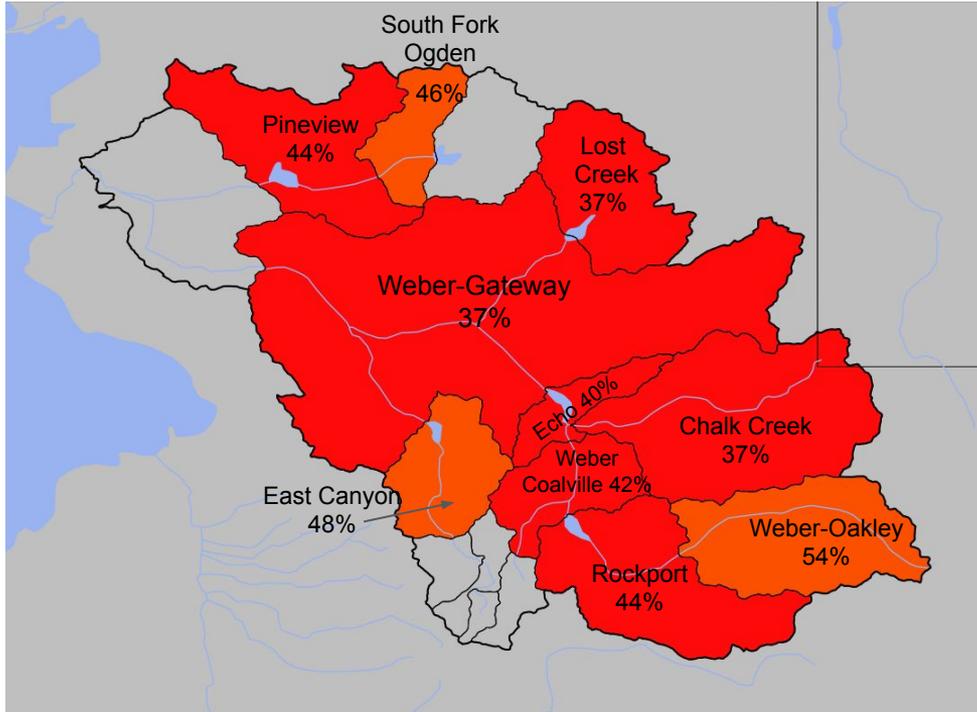
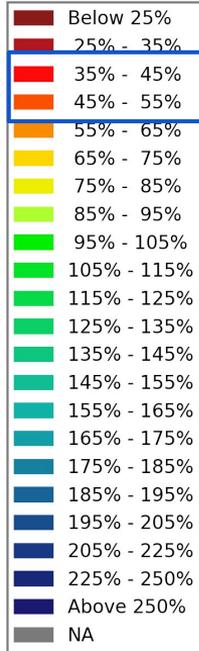
January: **55%** of Normal

February: **50%** of Normal

- Forecasts range from 20-70% of normal

# Utah Water Supply Forecasts - Weber

Percent of Average



## Weber River Basin Forecasts

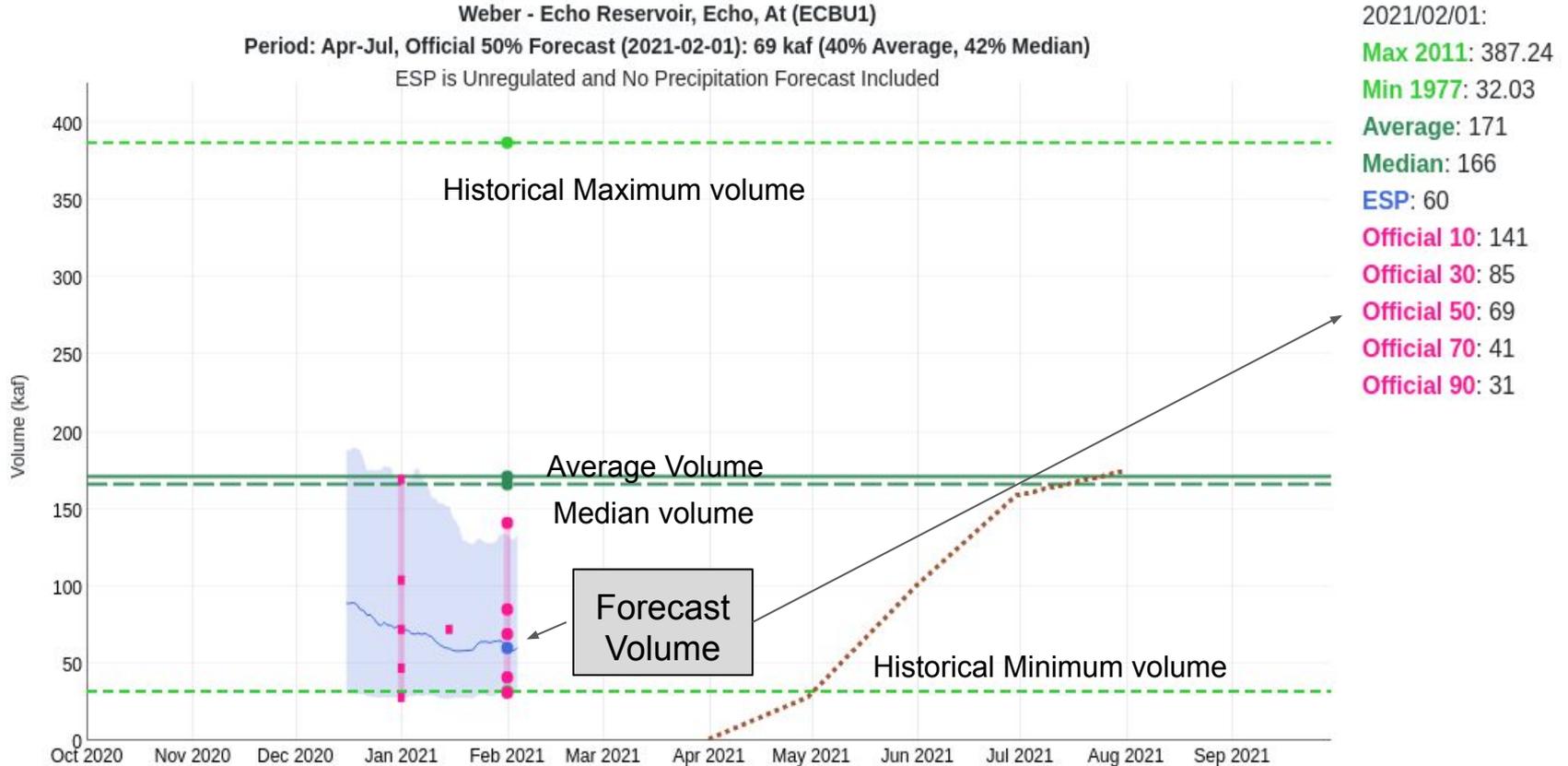
January: **45%** of Normal

February: **45%** of Normal

- Forecasts range from 35-55% of normal

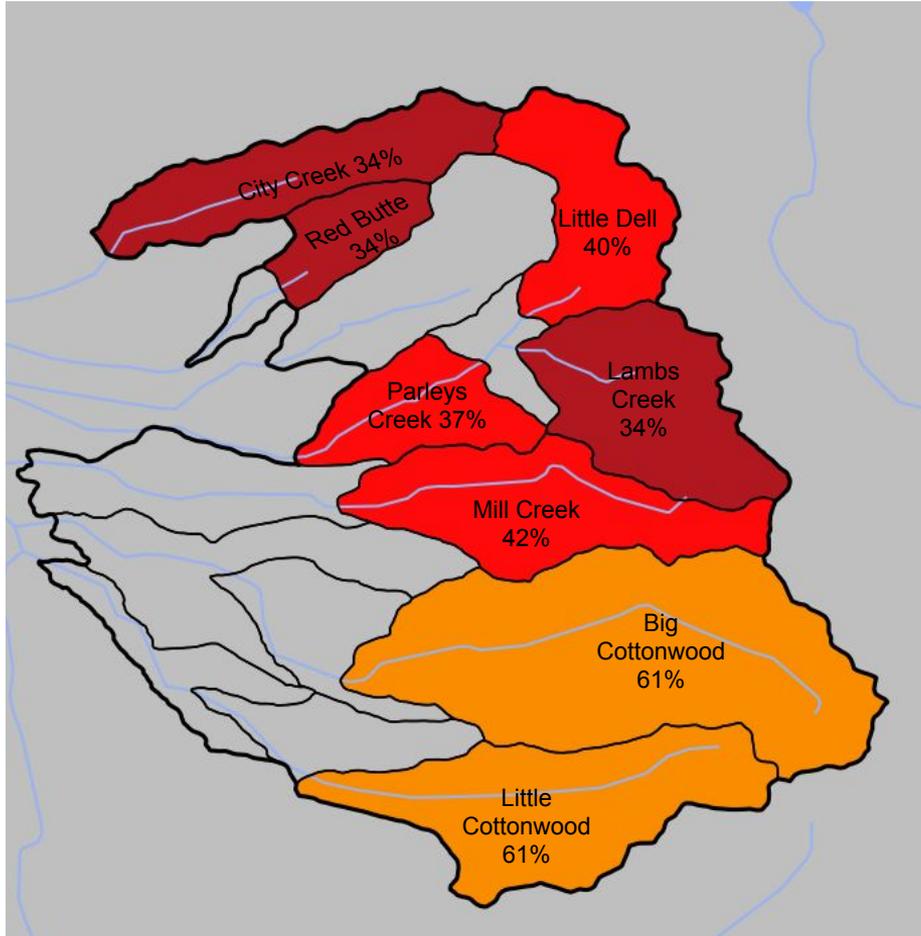
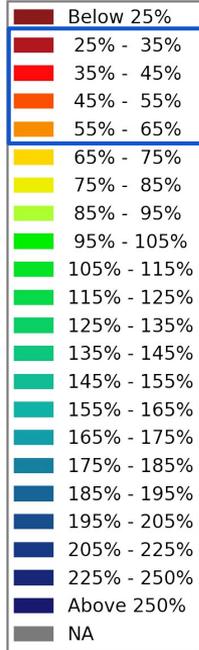
# Utah Water Supply Forecasts - Weber

## Echo Reservoir



# Utah Water Supply Forecasts - Six Creeks

Percent of Average



## Six Creeks Basin Forecasts

Median Forecast for Group

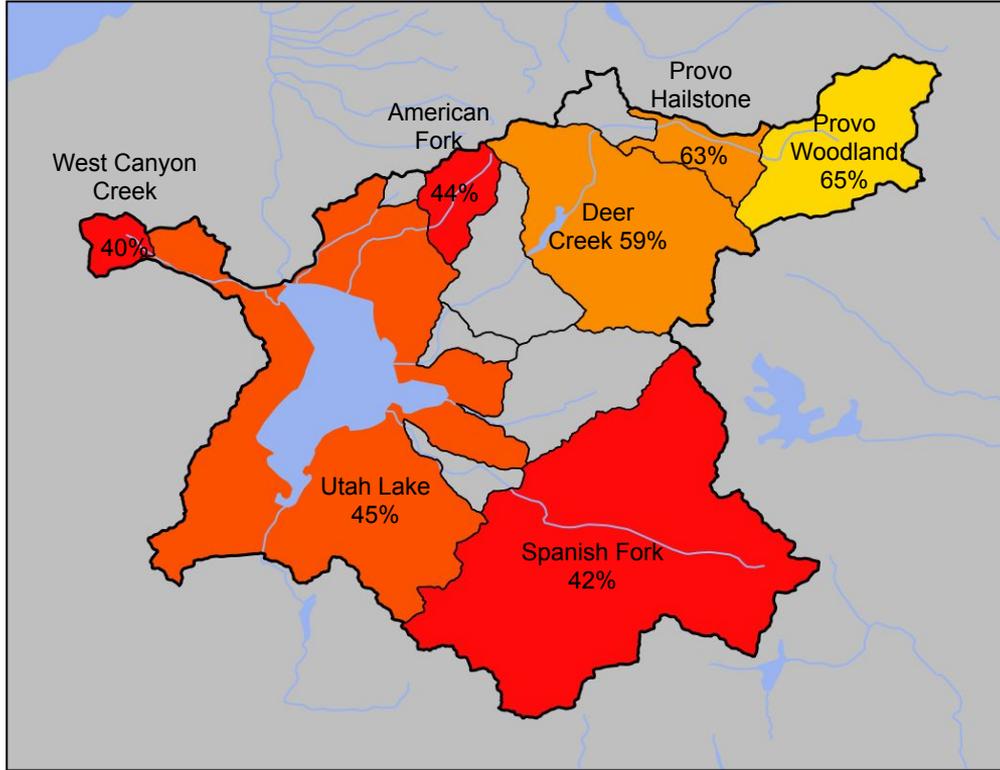
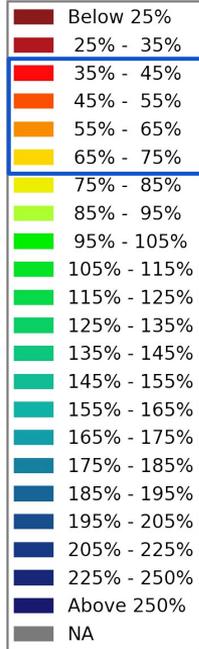
January: **40%** of Normal

February: **40%** of Normal

- Forecasts range from 35-60% of average

# Utah Water Supply Forecasts - Provo - Utah Lake

Percent of Average



## Provo River Basin Forecasts

### Median Forecast for Group

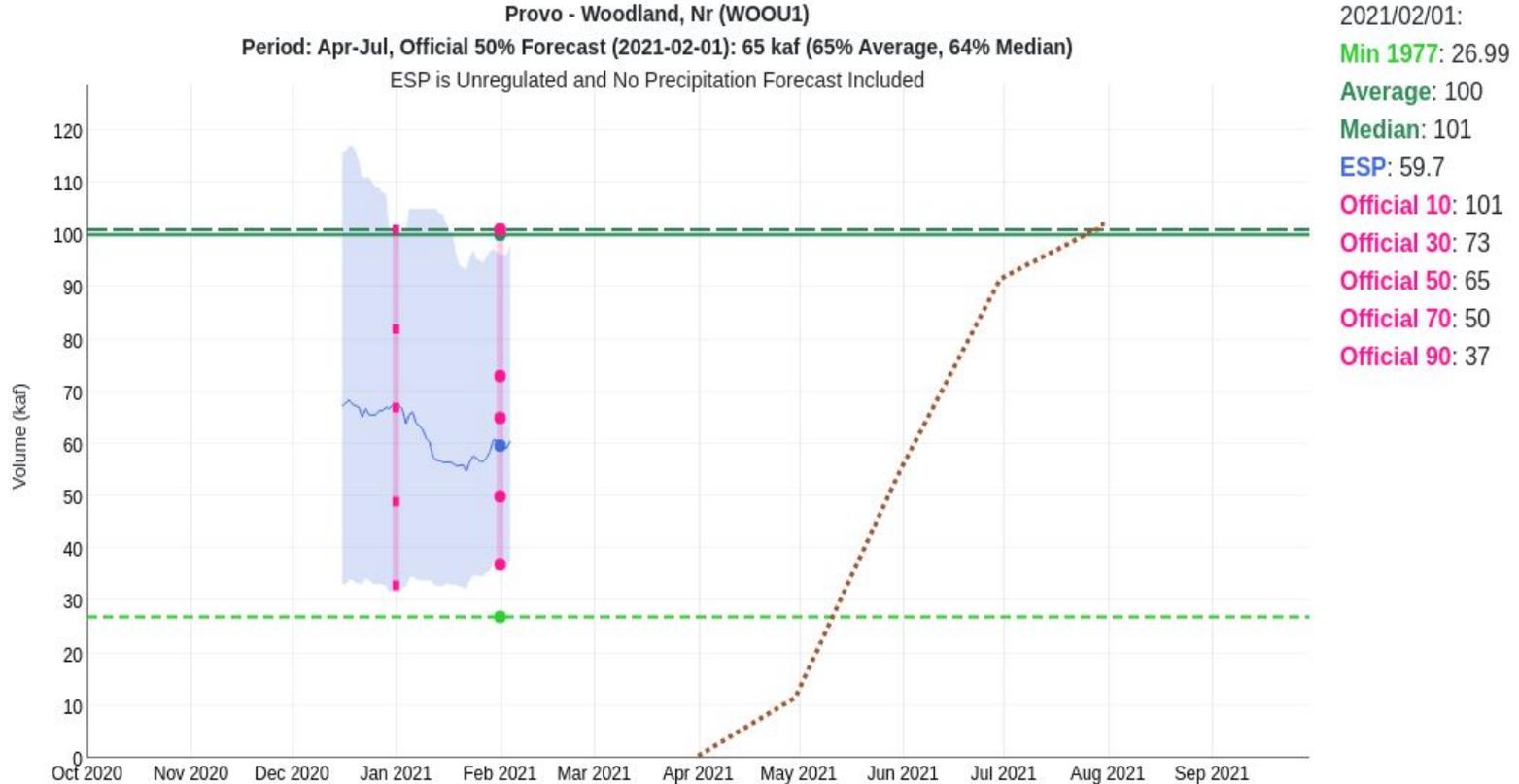
January: **50%** of Normal

February: **50%** of Normal

- Forecasts range from 40-65% of normal

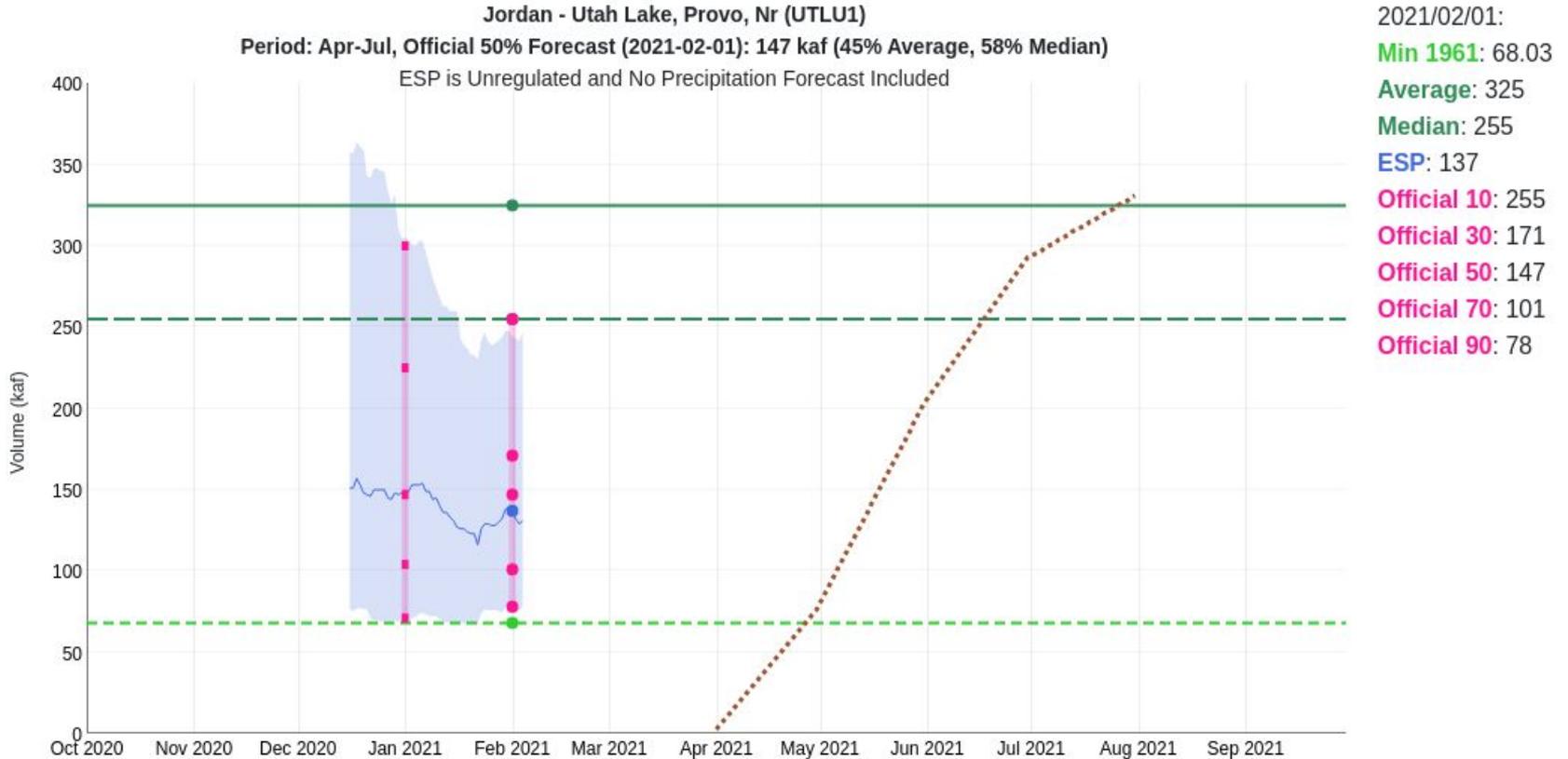
# Utah Water Supply Forecasts - Provo

Provo near Woodland



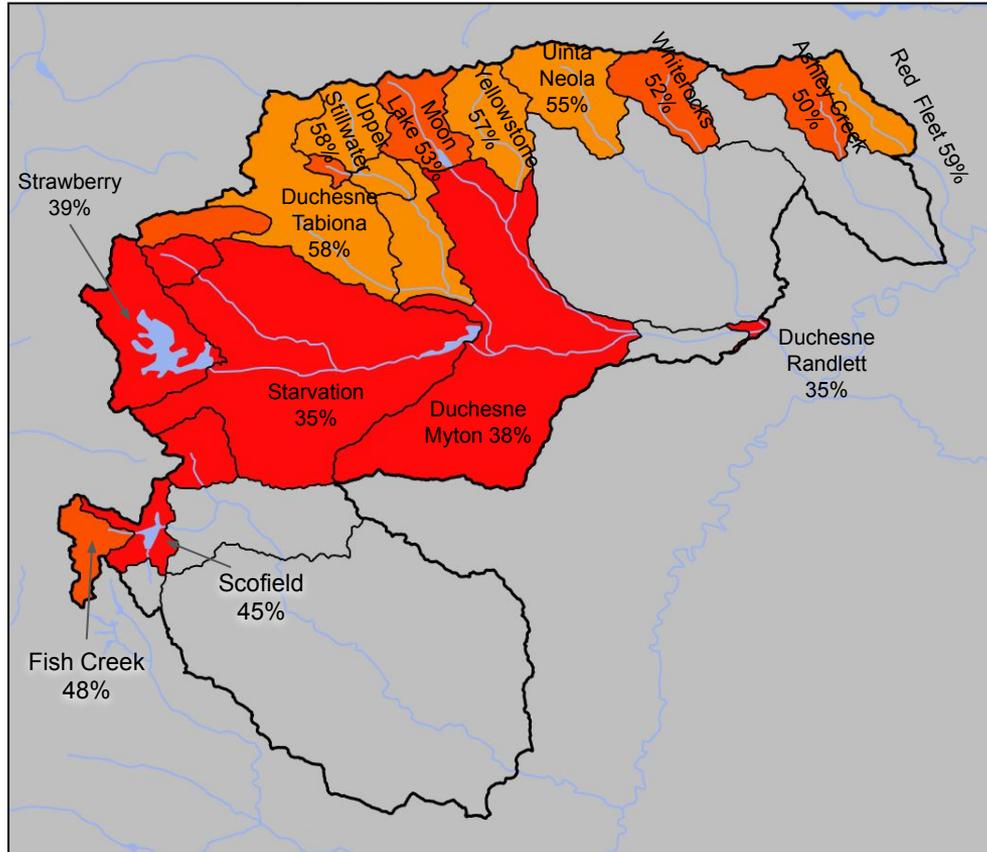
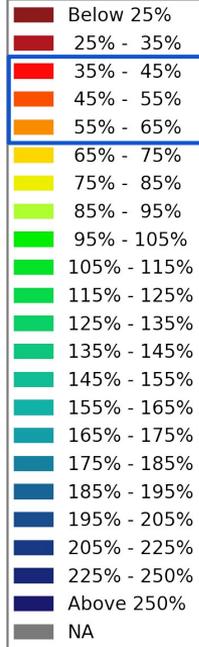
# Utah Water Supply Forecasts - Provo

## Utah Lake



# Utah Water Supply Forecasts - Duchesne

Percent of Average



## Duchesne River Basin

Median Forecast for Group

January: **50%** of Normal

February 1: **50%** of Normal

- Forecasts range from 35-60% of normal

## Price River Basin

Median Forecast for Group

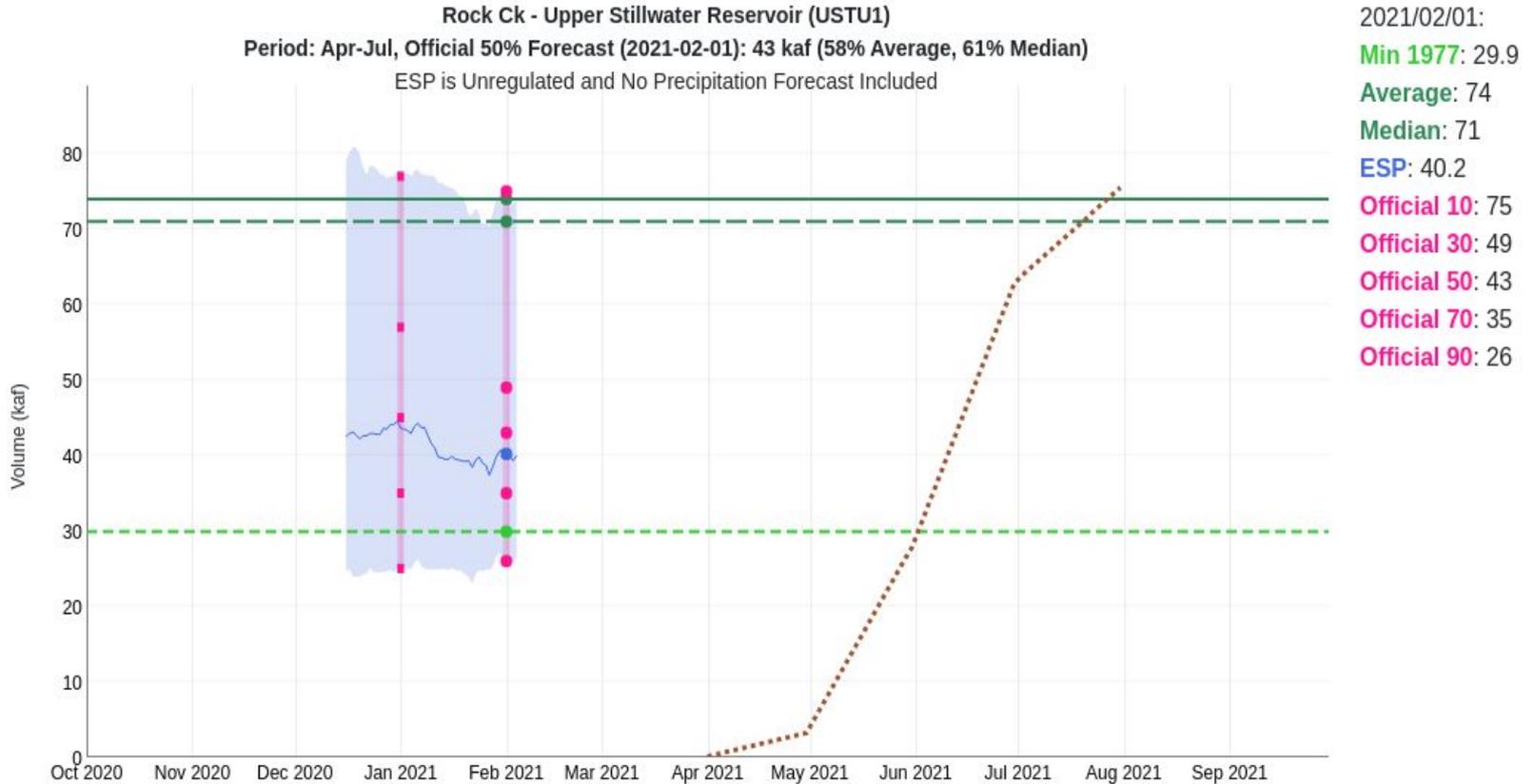
January: **50%** of Normal

February 1: **50%** of Normal

- Forecasts range from 40-55% of normal

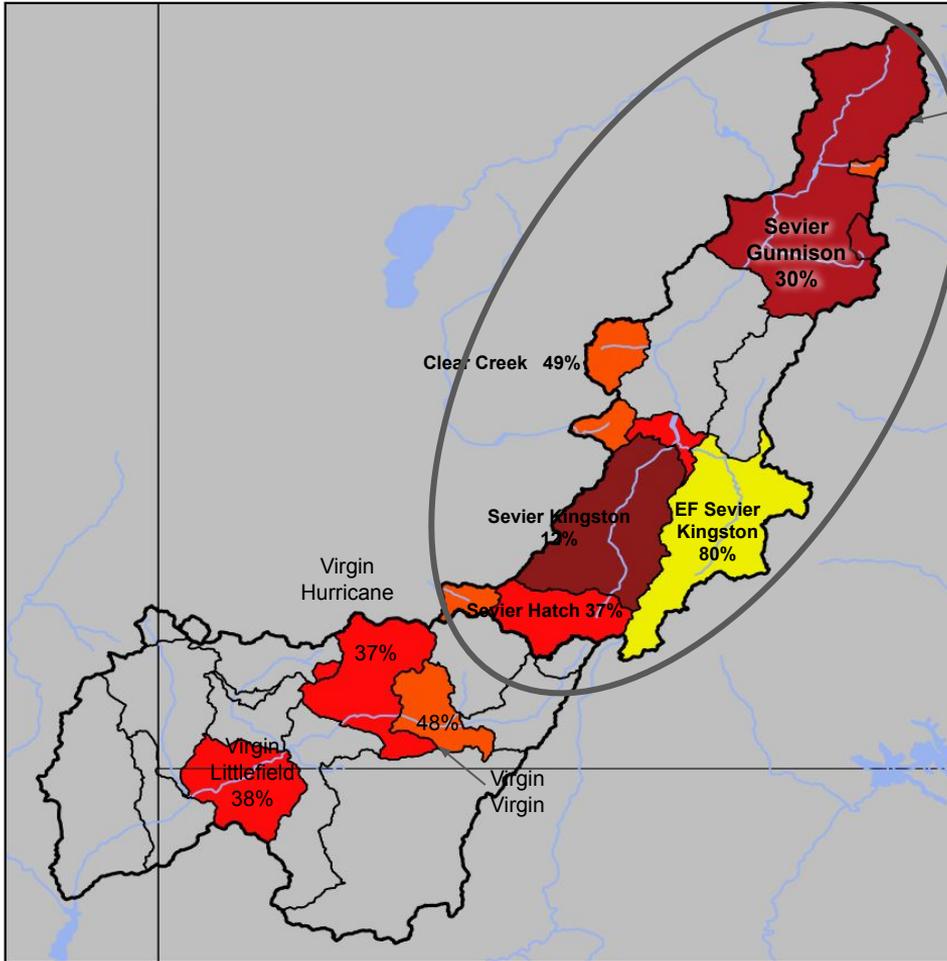
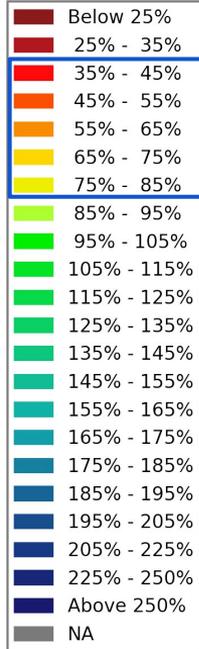
# Utah Water Supply Forecasts - Duchesne

## Upper Stillwater Reservoir



# Utah Water Supply Forecasts - Sevier and Virgin

Percent of Average



## Sevier River Basin Forecasts (regulated i.e. predicted Obs)

Forecast Median for Group

January: **40%** of Normal

February: **40%** of Normal

- Forecasts range from 35-80% of normal

## Virgin River Basin Forecasts

Forecast Median for Group

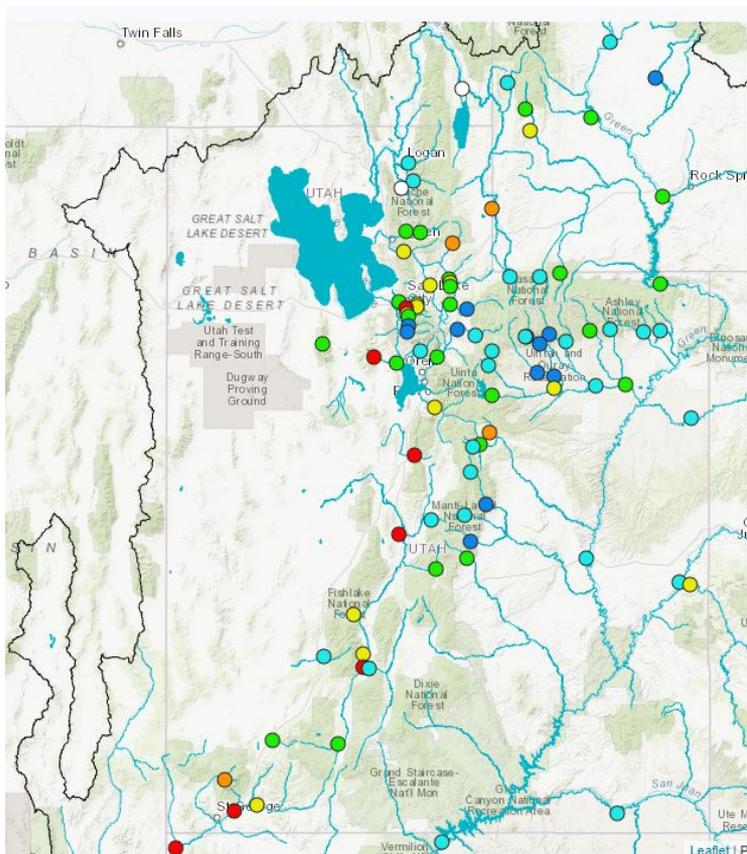
January: **35%** of Normal

February: **40%** of Normal

- Forecasts range from 35-50% of normal

# Historical (1981-2010) Forecast Verification

## February Forecast Error: April-July Volume



### Location

BEAR - UTAH-WYOMING STATE  
 BEAR - WOODRUFF NARROWS  
 LOGAN - LOGAN- NR  
 WEBER - OAKLEY- NR  
 WEBER - ROCKPORT RES  
 BIG COTTONWOOD CK  
 PARLEYS CK  
 PROVO - WOODLAND- NR  
 PROVO - DEER CK RES  
 VIRGIN - VIRGIN

### February Forecast Error

20%  
 38%  
 22%  
 19%  
 25%  
 18%  
 32%  
 20%  
 26%  
 34%

Forecasts are better than just going with average  
 Error tends to decrease each month into the spring

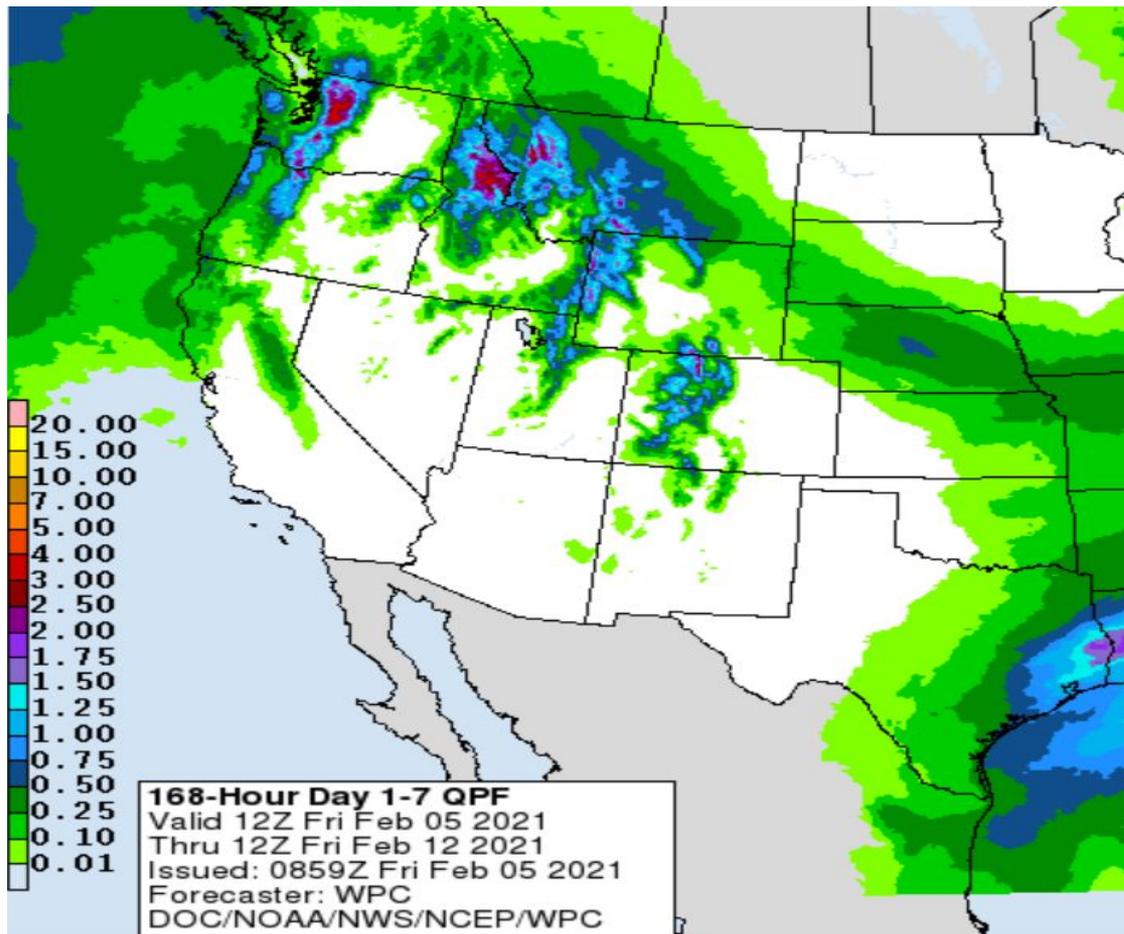
### Where Forecasts are Better:

- Headwaters
- Primarily snow melt basins
- Known diversions / demands

### Where Forecasts are Worse:

- Lower elevations (rain or early melt)
- Downstream of diversions / irrigation
- Little is known about diversions / demands

## Upcoming Weather: WPC February 5-12 Precipitation Outlook

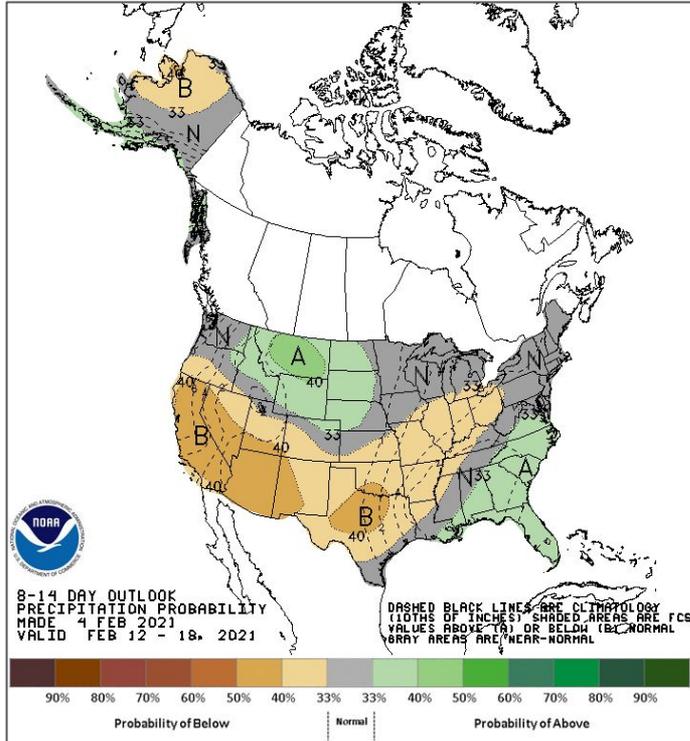


- Northwesterly flow to produce 1-2 inches of precip through across the mountains of Wyoming and northern Utah/Colorado.
- Little to no precip forecasted is forecast across southern Utah and the Lower Colorado Basin.

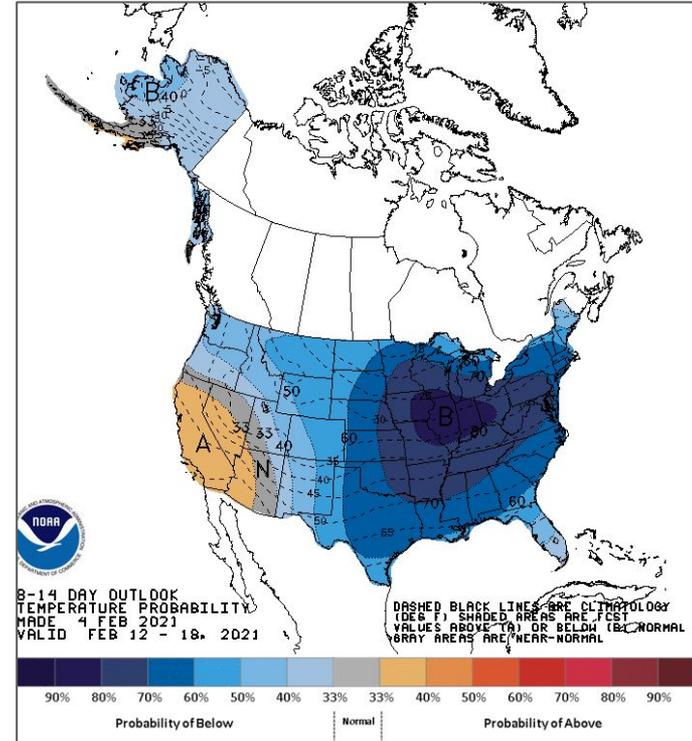
# Upcoming Weather: 8-14 Day Outlook (February 12-18)

Slightly elevated odds of below average precipitation across Utah.  
Temperatures mostly near to below normal.

## Precipitation Outlook



## Temperature Outlook

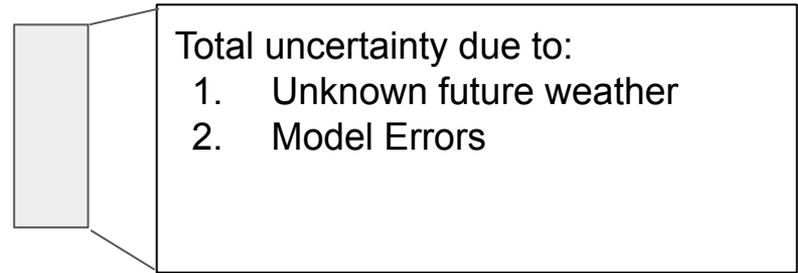


# Summary

- Utah basin conditions: low precipitation, low soil moisture, low snowpack.
- Recent precipitation across Utah has not been enough to “gain ground” on the water year deficit.
- Water Supply Forecasts reflect the dry start to the season and dry weather pattern.
  - All water supply forecasts are below normal
  - Most water supply forecasts have declined

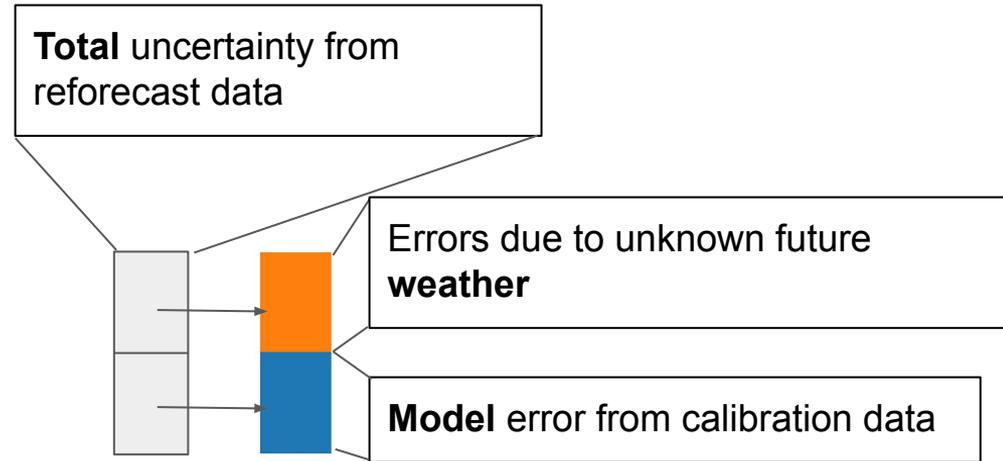
# Water Supply Forecast Errors

- Uncertainty in water supply forecasts are a combination of **model errors** and unknown future **weather** (mostly future precipitation).
- We can quantify total error in water supply forecasts by looking at 35 years of reforecast data.



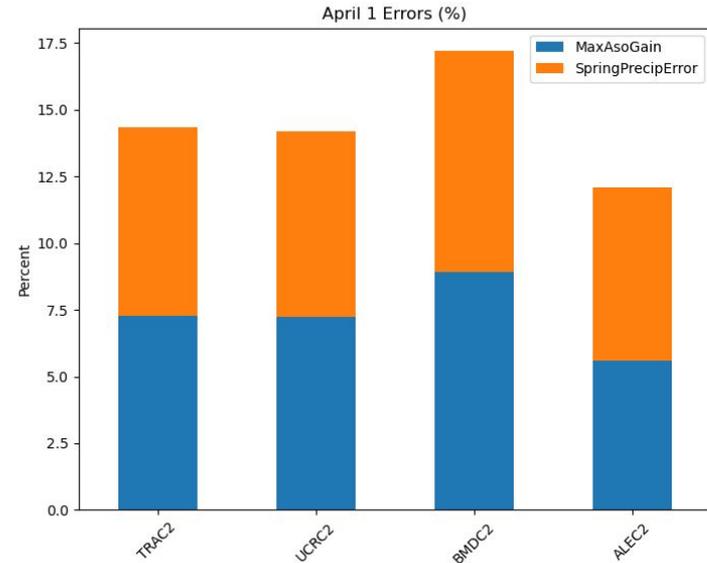
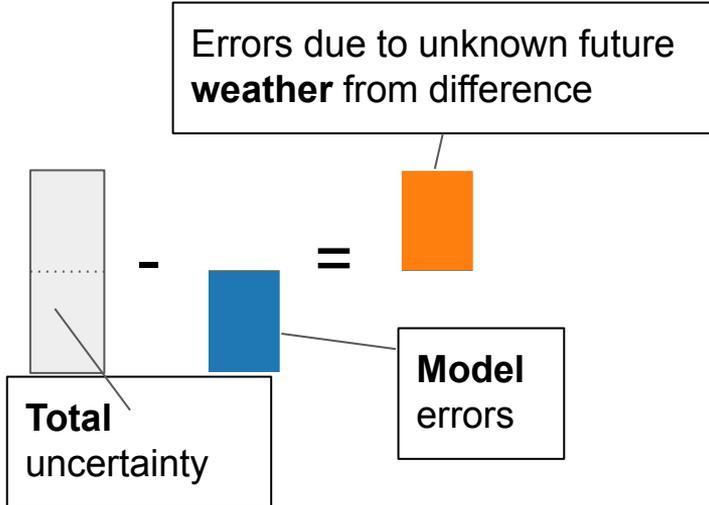
# Water Supply Forecast Errors

- **Model** errors can be attributed to...
  - Errors in model soil moisture
  - Errors in model snow pack
  - Errors in model parameters
  - Errors in model structure
  - Etc.
- We can quantify **model** errors by looking at 35 years of calibration data.



# Water Supply Forecast Errors

- Uncertainty due to unknown future **weather** is obtained by differencing.
- On average, roughly half of the volume error in an April 1 Water Supply forecast is attributed to the unknown spring **weather** (spring precip. amount).
- The other half is due to **model** errors.



# Continual quest to improve our forecasts

CBRFC is always looking for ways to improve our forecasts

- Future Weather Uncertainty

- Seasonal to subseasonal weather prediction
- Global Climate Indices (El Nino vs. La Nina)

- Model Errors

- Improved calibrations - every 5 years
- New datasets/products to incorporate into our model

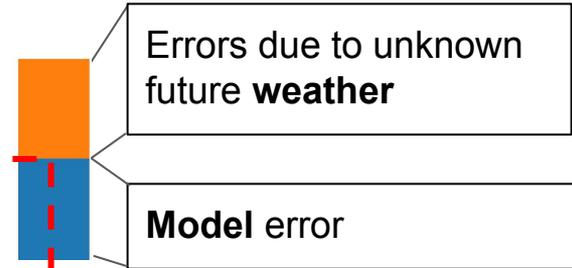
- External ET data sets

- External Snow Products

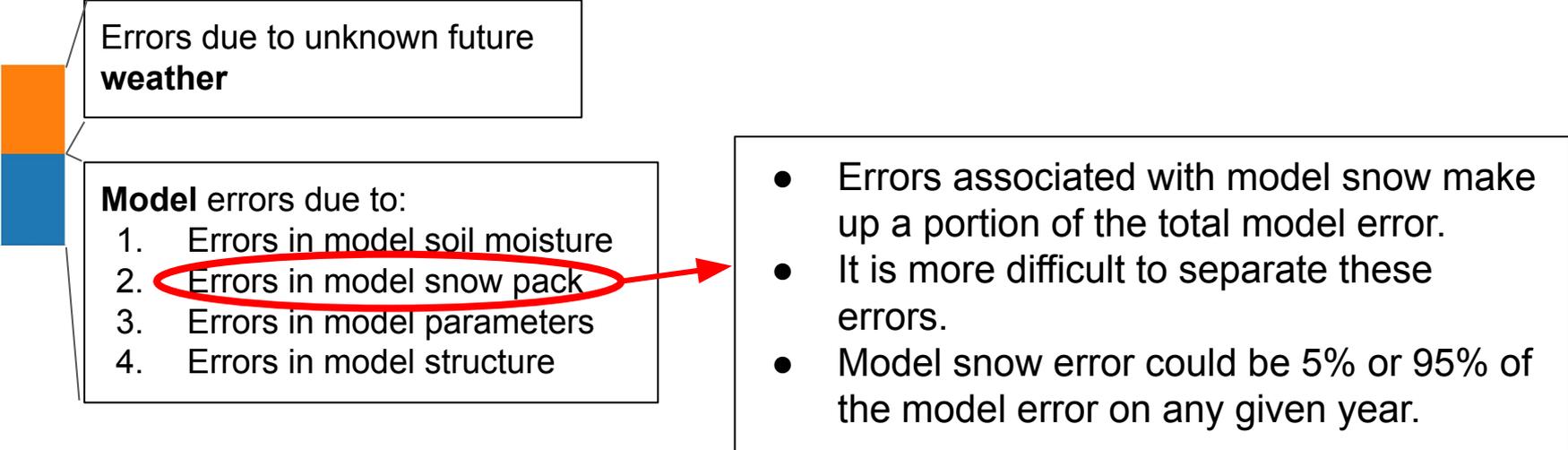
- MODIS - snow covered area, dust radiative forcing
- SWANN - Neural Network SWE product
- ASO - Airborne snow depth mapping and SWE estimation
- NOHRSC-SNODAS
- CU-JPL Real-Time Snowpack Estimations from Satellites

- Alternate models and methods

- Physically based snow models (UEB, iSnoBAL)
- Distributed Modeling - RDHM
- Data Assimilation
- Impacts of fires



# Error associated with current snow conditions



Errors due to unknown future **weather**

**Model** errors due to:

1. Errors in model soil moisture
2. Errors in model snow pack
3. Errors in model parameters
4. Errors in model structure

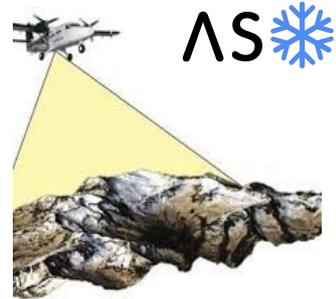
- Errors associated with model snow make up a portion of the total model error.
- It is more difficult to separate these errors.
- Model snow error could be 5% or 95% of the model error on any given year.

# Potential for ASO in CBRFC Water Supply Forecasts

## Background

ASO: Airborne Snow Observatory Inc.

ASO data: Estimated Gridded Snow Water Equivalent (SWE)



- Measured snow depth (airborne lidar)
- Estimated snow density (modeled, measured at points, combination)
- Gives an independent estimate of SWE in a basin or elevation zone

	2016	2017	2018	2019	2020	2021
Upper Gunnison			x	x	(x)	
Blue River				x		(x)
Uncompahgre	x	x				
Animas						(x)
Dolores						(x)

# 2018 and 2019 East at Almont - Gunnison

	Volume (kaf)		Snow Water Equivalent (in)		
	Calibration	Observed	Zone	Calibration	ASO
<b>Mar 31, 2018</b>	89	77	11000'-14216'	18.6	15.0 ↓
	Over simulated	Dry year: 42% avg.	9500'-11000'	7.3	8.3
			8016'-9500'	0.8	1.6
<b>Apr 7, 2019</b>	235	269	11000'-14216'	36.7	36.6
	Under simulated	Wet year: 148% avg.	9500'-11000'	18.8	22.4 ↑
			8016'-9500'	9.4	9.1

# Summary

- CBRFC is continually trying to improve forecasts.
- Water supply errors are a combination of model errors and unknown future weather errors.
- We are optimistic about the potential for incorporating ASO data and other external snow products to improve forecasts.

## More data is needed for a better assessment of ASO

- Current spatial extent covers 3-6 basin zones (1-2 basins) per flight
  - May need to extrapolate limited areal extent to additional basins
- We have a maximum of 2 years of data over the same basin (soon to be 3?).
- It would benefit CBRFC to have repeat flights in the same basin.

# 2021 Water Supply Webinar Schedule

*\*All Times Mountain Time (MT)*

## Colorado River Basin

Friday	Jan 8 <sup>th</sup>	10 am
Friday	Feb 5 <sup>th</sup>	10 am
Friday	Mar 5 <sup>th</sup>	10 am
Wednesday	Apr 7 <sup>th</sup>	10 am
Friday	May 7 <sup>th</sup>	10 am

## Utah

Friday	Jan 8 <sup>th</sup>	11:30 am
Friday	Feb 5 <sup>th</sup>	11:30 am
Friday	Mar 5 <sup>th</sup>	11:30 am
Wednesday	Apr 7 <sup>th</sup>	11:30 am
Friday	May 7 <sup>th</sup>	11:30 am

Peak flow forecast webinar Thursday, March 18<sup>th</sup>, 10 am MT

Additional briefings scheduled as needed

Webinar schedule & registration information has been posted to the CBRFC web page

# CBRFC Contacts & WY21 Basin Focal Points

**Michelle Stokes**

*Hydrologist In Charge*

**John Lhotak**

*Development and Operations Hydrologist*

**Paul Miller**

*Service Coordination Hydrologist*

**Cass Goodman**

*Computer Systems Analyst*

**Valerie Offutt**

*Administrative Assistant*

**Ashley Nielson**

*Upper Green, Yampa*

*San Juan, Dolores, Powell*

**Patrick Kormos**

*Lower Green, Duchesne*

*Weber, Provo*

**Cody Moser**

*Upper CO Mainstem, Gunnison*

**Brent Bernard**

*Bear, Sevier, Six Creeks*

**Zach Finch**

*Lower Colorado River Basin*

**Brenda Alcorn**

*Senior Hydrologist*

**Craig Peterson**

*Senior Hydrometeorologist*

**Tracy Cox**

*Hydrometeorologist*

**CBRFC Webpage**

<https://www.cbrfc.noaa.gov/>

**CBRFC Operations**

[cbrfc.operations@noaa.gov](mailto:cbrfc.operations@noaa.gov)

801-524-4004

**CBRFC Water Supply Presentations**

<https://www.cbrfc.noaa.gov/present/present.php>

[firstname.lastname@noaa.gov](mailto:firstname.lastname@noaa.gov)